Should Your Older Adult Patient Be Driving?

6

Quratulain Syed and Ned Wilson Holland Jr.

Introduction

America is a nation of highways. The automobile is an integral part of modern culture and a source of income, recreation, and freedom for many. Practically, the ability to drive a car allows older adults to socialize in the community, shop for essentials, and take care of themselves without being a burden on others. Many older adults may have been driving for 70 plus years. As a result, driving cessation can result in social isolation and depressive symptoms in a former driver and additional burden on the caregiver. Most older drivers are responsible drivers and are less likely than younger drivers to drive recklessly, at high speeds, or under the influence of alcohol [1]. Unfortunately, chronic medical conditions may limit the ability to drive safely, and the burden of chronic disease increases with age. The Centers for Disease Control and Prevention (CDC) reports that in 2010, motor vehicle injuries were the second leading cause of injury-related deaths among 65–85 year age group. The Fatality Analysis Reporting System data indicates that individuals aged 80 and older have a higher rate of fatality and injury in motor vehicle crashes per million miles driven than any other age group except for teenagers.

Many clinicians are not comfortable discussing driving safety with older patients. However, in reality determining an elderly person's ability to continue driving rests

Q. Syed (✉)
Division of General Medicine and Geriatrics, Department of Medicine, Grady Memorial Hospital, Emory University School of Medicine, 49 Jesse Hill Jr. Drive, Atlanta, GA 30303, USA
e-mail: qsyed@emory.edu

N.W. Holland Jr.
Division of General Medicine and Geriatrics, Department of Medicine, Emory University School of Medicine, Atlanta Veterans Affairs Medical Center, 1670 Clairmont Road, Decatur, GA 30033, USA
e-mail: Wilson.Holland@va.gov

L.A. Lindquist (ed.), *New Directions in Geriatric Medicine*,
DOI 10.1007/978-3-319-28137-7_6

on physicians' shoulders. Therefore, clinicians are more receptive to education to improve their skills in office evaluation of the elderly drivers [2]. In this article, we'll review some common conditions in older adults that can affect driving skills, evidence-based guidelines for driving in these conditions, and how to assess for driving safety in your patient.

Neurocognitive Disorders and Driving

Cognitive impairment due to Alzheimer's disease (AD) can affect memory, attention span, problem-solving skills, multitasking, orientation, judgment, and reaction speed, which can impair driving skills. Individuals with AD have been observed to make more safety and lane observance errors than controls and have higher rates of motor vehicle accidents (MVA) when the driver's approach to an intersection triggers an illegal incursion by another vehicle in simulated driving evaluations [3, 4]. Even in amnestic mild cognitive impairment, defined as very mild short-term memory deficits and slight impairment in problem-solving without functional decline, driving skills such as lane control may be impaired [5].

Frontotemporal dementia (FTD) has been associated with profound impairments in reasoning, task flexibility, planning, and execution. Persons with FTD are more likely to drive poorly, including speeding, running "stop" signs, and suffering more off-road crashes and collisions than controls [6].

Individuals with HIV-associated cognitive impairment experience impairment in executive function and visual attention and therefore are also at a higher rate of MVA compared to HIV-positive individuals without cognitive impairment [7, 8].

The diagnosis of dementia is insufficient to predict a person's ability to drive safely. Therefore, The American Academy of Neurology has proposed using the Clinical Dementia Rating (CDR) scale to identify individuals with dementia at increased risk of unsafe driving, as there is a strong (Level A) evidence relating dementia stage to driving risk [9, 10]. In mild dementia (CDR score of 1) when memory loss is accompanied by moderate difficulty in problem-solving and functional impairment in complex activities of daily living, as few as 41 % of drivers may drive safely. There is poor correlation between an individual's self-rating or caregiver's rating of driving abilities as "safe," and an on-road driving test (Level A evidence). However, a caregiver's rating of an individual's driving skills as marginal or unsafe is useful in identifying unsafe drivers (Level B evidence). Other "red flags" include recent traffic citations, motor vehicle accidents, self-reported situational avoidance, mini-mental state examination scores of 24 or less, or emergence of an aggressive or impulsive personality (Level C evidence) (Table 6.1) [9]. With amnestic mild cognitive impairment (CDR of 0.5), most drivers "pass" the driving evaluation, but the red flags described above may be used to guide driver evaluation referrals. Moderate to severe dementia (CDR score of 2 and 3) may result in severe impairment in memory, judgment, and ability to do complex activities of daily living. Therefore, these patents should be strongly encouraged to stop driving and use alternative means of transportation.

Table 6.1 Identifying at-risk driving patterns in individuals with cognitive impairment

Level of evidence	Characteristics useful in identifying unsafe drivers	Characteristics not useful in identifying unsafe drivers
A	Clinical Dementia Rating score	Patient's self-rating of driving ability as safe
B	Caregiver's rating of driving ability as marginal or unsafe	
C	History of traffic citations or crashes	Lack of situational avoidance
	Reduced driving mileage	
	Self-reported situational avoidance	
	MMSE scores <24	
	Aggressive or impulsive personality	

The trail-making test part B (aka Trails B) which can be administered in 3–5 min highly correlates with recent or future at-fault MVA [11, 12]. It can be employed by clinicians to screen for fitness to drive in busy office settings.

A detailed neuropsychological assessment may be useful for evaluation of memory, spatial cognition, and executive functioning if questions about the diagnosis of dementia. However, there is insufficient evidence to support referral for neuropsychological testing to assess driving risk in patients with dementia.

There is no evidence to support or refute benefit of interventional strategies as driver rehabilitation for drivers with dementia.

Parkinson's Disease and Driving

Drivers with Parkinson's disease (PD) have been noted to have problems with lateral position on the road at speed below 50 km/h, speed adaptations at speed above 50 km/h, turning left maneuvers, lane keeping, observing their blind spot, backing up, parking, and negotiating traffic light [13, 14]. They also have poorer vehicle control in low-contrast visibility conditions as fog and are at higher risk for crashes in these circumstances [15].

Level B evidence exists for the useful field of view, contrast sensitivity, trails B and B–A (B–A = time on trails A subtracted from time on trails B), functional reach, and Unified Parkinson's Disease Rating Scale "off" motor scores for probably predicting driving performance [16].

Clinicians can perform functional reach test and trails B in their office for initial assessment. Individual with mild motor disability from PD may be fit for driving. They should be referred for a baseline driving evaluation upon diagnosis and then yearly for reassessment. There should be a plan to recommend cessation of driving and using alternate mode of transportation as the disease progresses. For individuals with severe motor impairment and disease severity, cessation of driving should be recommended [17].

Cardiovascular Diseases and Driving

Sudden incapacitation of the driver is estimated to be responsible for up to 3 % of all motor vehicle accidents, and approximately 10 % of these episodes are noted to be of cardiac origin [18]. Up to 35 % of all syncopal episodes while driving are neurally mediated and include neurocardiogenic syncope, situational syncope, and carotid sinus hypersensitivity constitutes. Cardiac arrhythmias (including bradyarrhythmias, supraventricular tachyarrhythmias, ventricular tachyarrhythmias) followed by orthostatic intolerance are other common causes of syncope while driving [19, 20].

Approximately 17–40 % of patients with history of syncope may have recurrences within a year of follow-up. In patients who have had a syncopal episode while driving, the actuarial recurrence of syncope is 14 % at 1 year. Driving restriction should therefore be recommended for patients with recurrent or severe syncopal episodes, until a cause is identified and symptoms are controlled. As the causes and rates of recurrence of syncope are similar in patients who have it while driving and in those who have it while not driving, driving-related recommendations also apply to both [21]. Table 6.2 lists common cardiac arrhythmias and driving recommendations for those conditions.

Table 6.2 Driving recommendations for individuals with cardiac arrhythmias

Cardiac arrhythmias	Treatment	Driving restrictions	
		Private drivers	Commercial drivers
Symptomatic bradycardia	Discontinue offending medicine	After successful treatment	
	Pacemaker implantation	After 1–4 weeks	When pacemaker functioning appropriately
Supraventricular tachyarrhythmias	Medical treatment	After successful treatment	
	Catheter ablation	After successful treatment	After establishing long-term success
Ventricular arrhythmias	Medical treatment	After successful treatment	
	Catheter ablation	After successful treatment	After establishing long-term success
	ICD implant: primary prevention	4 weeks	Permanent
	ICD implant: secondary prevention	3 months (EHRA)	Permanent
		6 months (AHA)	
	Replacement of ICD	1 week	Permanent
	Replacement of lead system	4 weeks	Permanent
	Refusal of ICD: primary prevention	No restriction	Permanent
	Refusal of ICD: secondary prevention	7 months	Permanent

Adapted from Sorajja et al., Consensus statement of the European Heart Rhythm Association (EHRA) and the American Heart Association (AHA) and the North American Society of Pacing and Electrophysiology [21, 46, 47]

For patients who have implantable cardioverter defibrillator (ICD), device discharges are frequent. For individuals with history of ventricular tachycardia/fibrillation, 5 years actuarial incidence of appropriate ICD shocks ranges between 55 and 70 %. Also up to 30 % of individuals experience a syncopal or near-syncopal episode during an appropriate ICD shock [22]. However, in a survey of participants of Antiarrhythmics Versus Implantable Defibrillators (AVID) trial, none of the motor vehicle accidents were preceded by the driver receiving shock from ICD [23].

Polypharmacy and Driving

Two-thirds of people aged 65 and older take five or more medications daily. Psychoactive drugs (including benzodiazepines and tricyclic antidepressants) can result in impaired tracking and coordination, increased reaction time, and increase risk of MVA requiring hospitalization in older drivers [24]. Additionally, antiepileptics, dopaminergic medicines, muscle relaxants, hypoglycemics, antihistamines, and centrally acting muscle relaxants can affect the level of alertness and cause MVA [25]. The "Roadwise Rx" is a free online tool developed by American Automobile Association Foundation for Traffic Safety [26]. It allows a clinician (or patient) to enter the names of medicines and check if a medication can affect driving. Clinicians should also review their patients' medications periodically to eliminate unnecessary medicines and trim down the medication lists. The Beers List, "START" (screening tool to alert doctors to right treatment), and "STOPP" (screening tool of older person's prescriptions) tools can be useful in identifying potentially inappropriate medications [27, 28].

Vision Impairment and Driving

For safe driving, a driver should have adequate central vision to be able to see road signs, roadside objects, traffic lights, roadway markings, pedestrians, and other vehicles on the road, while the car is moving, under varying light and weather conditions. The driver should also have adequate depth perception and peripheral vision to be able to judge distance and speed and monitor objects and movement in the vicinity to identify possible threats in the driving environment. Central vision can be affected by age-related macular degeneration and cataracts, whereas glaucoma and strokes can affect peripheral vision. Cataracts can affect night vision and cause glare and contrast sensitivity.

The licensing authorities in the USA currently rely on visual acuity for vision screening for licensing purposes, which doesn't assess peripheral vision, visual attention, depth perception, and contrast sensitivity. Therefore, state laws pertaining to vision tests have not been associated with a lower fatality rate among older drivers [29]. Clinicians should counsel patients on their driving risk based on the diagnosis and treatment potential. Drivers undergoing cataract surgeries have been noted to have improvement in visual acuity and self-reported improvement in daytime

driving up to 5 years after the surgery, though it doesn't significantly affect night driving [30]. Therefore, surgical correction of cataracts should be recommended to allow drivers with cataracts to continue driving.

Hearing Impairment and Driving

Moderate self-reported hearing loss, especially in the right ear, has been associated with higher rates of motor vehicle accidents among drivers aged 50 and older [31]. Drivers with dual sensory impairment are at a greater risk of motor vehicle accidents than those with only hearing or vision impairment [32]. Additionally, moderate to severe hearing impairment in older drivers is associated with worse driving performance in the presence of visual and auditory distracters [33].

Older adults with self-reported hearing impairment should be counseled to undergo hearing evaluation, followed by counseling to limit distracters during driving and use hearing aids if there is moderate hearing impairment. For those with severe hearing impairment or additional vision impairment, limiting driving and using alternate mode of transportation should be discussed.

Orthopedic Surgeries and Driving

A driver's ability to navigate steering wheel or apply brakes can be affected by an injury or a recent surgery of upper or lower extremities. Postoperative pain can also cause distraction and affect safe operation of a motor vehicle. The use of casts, slings, splints, and knee and elbow immobilizers can also affect an individual's ability to use the affected extremity to navigate the motor vehicle. Typically, impairment in driving ability is measured by changes in the time needed to perform an emergency stop. Recommendations regarding optimal time to resume driving after various elective or emergency orthopedics surgeries have been summarized in Table 6.3.

Table 6.3 Driving recommendations for individuals undergoing orthopedic procedures

Orthopedics procedures	When to resume driving
Knee arthroscopy (excluding ACL)	4 weeks
Right ACL reconstruction	4–6 weeks
Left ACL reconstruction	2 weeks
Right total knee arthroplasty	10 days- 8 weeks
Right total hip arthroplasty	6–8 weeks
Right ankle fracture	9 weeks
Bunion surgery	6 weeks
Major lower extremity fracture	6 weeks after initial weight bearing
Discectomy for radiculopathy	After discharge from hospital
Lumbar spinal fusion	After discharge from hospital

Adapted from Marecek et al. [48] and Goodwin et al. [49]

Physical Impairment and Driving Safety

Generalized physical debility as manifested by increased risk of falls can be a predictor of impaired driving skills, as both of these tasks require attention and ability to multitask. Individuals at high risk of falls, measured by Physiological Profile Assessment, have been noted to have a significantly slower response time to critical events during simulated driving assessment (400 ms slower) compared with low falls-risk drivers [34].

Epilepsy and Driving

Drivers with history of seizures run the risk of sudden incapacitation during a seizure episode, which can lead to harm to self or others if the driver is behind the wheels. However, this risk is very low if seizure disorder is controlled. Most studies show that drivers with history of seizures are not at any higher risk of MVA compared to drivers with other chronic medical conditions [35]. Physicians should refer to their state regulations governing reporting of epilepsy and breakthrough seizures.

Sleep Disturbance and Driving Safety

Sleep disorders including primary insomnia, obstructive sleep apnea (OSA), and circadian rhythm sleep disorders can result in reduced alertness, increased sleepiness during driving, and increased risk of MVA [36, 37]. A driver exhibiting moderate to severe daytime sleepiness and a recent unintended MVA or a near-miss due to sleepiness, fatigue, or inattention is a high-risk driver. For noncommercial drivers, treatment of OSA should be encouraged to reduce risk of drowsy driving. Compliance with continuous positive airway pressure (CPAP) for at least 4 h a night for >70 % of nights is recommended [38]. Also driving restriction should be recommended till symptoms improve. There is no compelling evidence to restrict driving privileges in patients with sleep apnea if there has not been a motor vehicle crash or an equivalent event. The American Thoracic Society clinical practice guidelines recommend against the use of stimulant medicines to improve alertness during driving in individuals with OSA [39].

It is recommended that commercial drivers should undergo a screening of symptoms of OSA during in-service evaluation and further evaluation as needed. They should also undergo out-of-service evaluation if observed or confessed excessive somnolence or road traffic accidents due to increased somnolence [40].

The Copilot Phenomenon

The copilot phenomenon describes a caregiver or partner of the driver who sits beside the driver when he/she drives and gives directions. This is an extremely important red flag to look for in the at-risk elderly drivers.

Evaluation

There are three key functions for safe driving: vision, cognition, and motor/somatosensory function. The American Medical Association recommends assessment of driving-related skills (ADReS) test battery (see Table 6.4) which can be performed by a clinician in office to assess many key areas of the important functions which have been validated with driving outcomes [41]. It is important to note that ADReS is an assessment of important functional domains but is not a predictor of motor vehicle accidents. Additionally, a study by Ott et al. suggests that some of the ADReS may be better than others in assessing driving-related skills. In particular, trail-making test part B, rapid pace walk, and range of motion testing in office correlate best with on-road tests [42].

If there are concerns about a patient's ability to drive safely, clinicians can refer the patient to a certified driver rehabilitation specialist (CDRS) for driving assessment. The driving assessment usually includes an assessment of the driver's knowledge of traffic signs and laws, a cognitive assessment, a simulation test, and finally an on-road driving evaluation if deemed appropriate. Information about CDRS in your area can be obtained on the website of Association for Driver Rehabilitation Specialists (ADED).

In general, Medicare and other private insurances do not reimburse for driving services. The cost of driving assessment and rehabilitation is generally out of pocket and can vary from $100 to $500+ based on services provided and coverage provided by Medicare or private insurances, which varies from state to state.

How to Broach the Topic of Driving Assessment and Cessation During Your Clinic Encounter

Many older adults become defensive when driving is discussed, due to the fear that they may be asked to stop driving and may therefore lose their independence. It is best to discuss this issue directly in a non-confrontational approach, emphasizing your concern about your patient's safety and efforts to ensure that your patient can drive safely for as long as possible. Having a family member or friend present during the conversation can be helpful. It also helps reassuring your patient that a physician or occupational therapist doesn't have the legal authority to take away drivers'

Table 6.4 Assessment of driving-related skills (ADReS) in office

Components of assessment of driving-related skills (ADReS)	
Visual fields	Motor strength
Visual acuity	Trail-making test part B
Rapid pace walk	Clock drawing test
Range of motion	

Adapted from and available at: http://www.nhtsa.gov/people/injury/olddrive/OlderDriversBook/pages/ADReSscore.html

licenses. However, physicians should inform their patients about their responsibility to report to the Department of Motor Vehicle (DMV) medical conditions that may impair safe operation of a motor vehicle.

For many patients, driving cessation may not be the immediate goal, and focusing on options for safer driving such as not driving at night time and limiting driving to familiar areas may be sufficient for a period of time with close follow-up. When the clinician feels that the elderly driver is approaching the time to "give up the keys," discussing the importance of driving being a privilege, the safety of the patient and the safety of others should be emphasized. The American Medical Association suggests giving these drivers a prescription saying "Do Not Drive, For Your Safety and the Safety of Others." Focusing on alternatives that may allow them to stay connected with outdoor activities and developing alternative action plans with the elderly drivers and their families may reduce anxiety and depression that can develop when the elderly relinquish their driving privileges.

Reporting an Unsafe Driver

If a clinician believes that a patient has medical conditions that may impair safe operation of a motor vehicle, and put life of the patient or others at risk, the clinician should report to the local DMV in accordance with the state's mandatory reporting laws and standards of medical practice. The clinician should maintain the patient's confidentiality by ensuring that only the minimally required information is reported.

Follow-Up After Driving Cessation

Driving cessation can result in decline in overall health and increased depression in a former elderly driver who may have been driving for years [43–45]. Therefore, it is extremely important to follow up after counseling your patients to stop driving, to ensure that there is an alternative transportation option in place to allow the elderly to socialize and take care of their health and daily needs.

Key Points

1. There are three key functions for safe driving: vision, cognition, and motor/somatosensory function.
2. The licensing authorities in the USA currently rely on visual acuity for vision screening for licensing purposes, which doesn't assess peripheral vision, visual attention, depth perception, and contrast sensitivity.
3. The diagnosis of dementia is insufficient to predict a person's ability to drive safely.
4. There is no evidence to support or refute benefit of interventional strategies as driver rehabilitation for drivers with dementia.

5. In evaluating medications, the "Roadwise Rx" is a free online tool developed by AAA Foundation for Traffic Safety that allows a clinician (or patient) to enter the names of medicines and check if a medication can affect driving.
6. Moderate self-reported hearing loss, especially in the right ear, has been associated with higher rates of motor vehicle accidents among drivers aged 50 and older.
7. The copilot phenomenon, which describes a person who sits beside the driver when he/she drives and gives directions, is an extremely important red flag to look for in the at-risk elderly drivers.
8. If a clinician believes that a patient may be unsafe to drive, he or she should report in accordance with the state's mandatory reporting laws.

Abbreviations

ADReS	Assessment of driving-related skills
ADED	Association of driver rehabilitation specialists
CDRS	Certified driver rehabilitation specialist
CDR	Clinical Dementia Rating scale
CPAP	Continuous positive airway pressure
DMV	Department of Motor Vehicle
FTD	Frontotemporal dementia
ICD	Implantable cardioverter defibrillator
MVA	Motor vehicle accident
OSA	Obstructive sleep apnea
PD	Parkinson's disease
START	Screening tool to alert doctors to right treatment
STOPP	Screening tool of older person's prescriptions

References

1. Williams AF. Teenage drivers: patterns of risk. J Safety Res. 2003;34(1):5–15.
2. Marshall S, Demmings EM, Woolnough A, Salim D, Man-Son-Hing M. Determining fitness to drive in older persons: a survey of medical and surgical specialists. Can Geriatr J. 2012;15(4):101–19.
3. Rizzo M, McGehee DV, Dawson JD, Anderson SN. Simulated car crashes at intersections in drivers with Alzheimer disease. Alzheimer Dis Assoc Disord. 2001;15(1):10–20.
4. Dawson JD, Anderson SW, Uc EY, Dastrup E, Rizzo M. Predictors of driving safety in early Alzheimer disease. Neurology. 2009;72(6):521–7.
5. Griffith HR, Okonkwo OC, Stewart CC, Stoeckel LE, Hollander JA, Elgin JM, et al. Lower hippocampal volume predicts decrements in lane control among drivers with amnestic mild cognitive impairment. J Geriatr Psychiatry Neurol. 2013;26(4):259–66.
6. de Simone V, Kaplan L, Patronas N, Wassermann EM, Grafman J. Driving abilities in frontotemporal dementia patients. Dement Geriatr Cogn Disord. 2007;23(1):1–7.

7. Marcotte TD, Lazzaretto D, Scott JC, Roberts E, Woods SP, Letendre S, et al. Visual attention deficits are associated with driving accidents in cognitively-impaired HIV-infected individuals. J Clin Exp Neuropsychol. 2006;28(1):13–28.
8. Marcotte TD, Wolfson T, Rosenthal TJ, Heaton RK, Gonzalez R, Ellis RJ, et al. A multimodal assessment of driving performance in HIV infection. Neurology. 2004;63(8):1417–22.
9. Iverson DJ, Gronseth GS, Reger MA, Classen S, Dubinsky RM, Rizzo M, et al. Practice parameter update: evaluation and management of driving risk in dementia: report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology. 2010;74(16):1316–24.
10. Morris JC. The Clinical Dementia Rating (CDR): current version and scoring rules. Neurology. 1993;43(11):2412–4.
11. Stutts JC, Stewart JR, Martell C. Cognitive test performance and crash risk in an older driver population. Accid Anal Prev. 1998;30(3):337–46.
12. Ball KK, Roenker DL, Wadley VG, Edwards JD, Roth DL, McGwin G, et al. Can high-risk older drivers be identified through performance-based measures in a department of motor vehicles setting? J Am Geriatr Soc. 2006;54(1):77–84.
13. Wood JM, Worringham C, Kerr G, Mallon K, Silburn P. Quantitative assessment of driving performance in Parkinson's disease. J Neurol Neurosurg Psychiatry. 2005;76(2):176–80.
14. Devos H, Vandenberghe W, Tant M, Akinwuntan AE, De Weerdt W, Nieuwboer A, et al. Driving and off-road impairments underlying failure on road testing in Parkinson's disease. Mov Disord. 2013;28(14):1949–56.
15. Uc EY, Rizzo M, Anderson SW, Dastrup E, Sparks JD, Dawson JD. Driving under low-contrast visibility conditions in Parkinson disease. Neurology. 2009;73(14):1103–10.
16. Crizzle AM, Classen S, Uc EY. Parkinson disease and driving: an evidence-based review. Neurology. 2012;79(20):2067–74.
17. Classen S. Consensus statements on driving in people with Parkinson's disease. Occup Ther Health Care. 2014;28(2):140–7.
18. Petch MC. Driving and heart disease. Eur Heart J. 1998;19(8):1165–77.
19. Sorajja D, Nesbitt GC, Hodge DO, Low PA, Hammill SC, Gersh BJ, et al. Syncope while driving clinical characteristics, causes, and prognosis. Circulation. 2009;120(11):928–34.
20. Blitzer ML, Saliba BC, Ghantous AE, Marieb MA, Schoenfeld MH. Causes of impaired consciousness while driving a motorized vehicle. Am J Cardiol. 2003;91(11):1373–4.
21. Sorajja D, Shen WK. Driving guidelines and restrictions in patients with a history of cardiac arrhythmias, syncope, or implantable devices. Curr Treat Options Cardiovasc Med. 2010;12(5):443–56.
22. Freedberg NA, Hill JN, Fogel RI, Prystowsky EN, Group C. Recurrence of symptomatic ventricular arrhythmias in patients with implantable cardioverter defibrillator after the first device therapy: implications for antiarrhythmic therapy and driving restrictions. CARE Group. J Am Coll Cardiol. 2001;37(7):1910–5.
23. Akiyama T, Powell JL, Mitchell LB, Ehlert FA, Baessler C. Antiarrhythmics versus implantable defibrillators I. Resumption of driving after life-threatening ventricular tachyarrhythmia. N Engl J Med. 2001;345(6):391–7.
24. Meuleners LB, Duke J, Lee AH, Palamara P, Hildebrand J, Ng JQ. Psychoactive medications and crash involvement requiring hospitalization for older drivers: a population-based study. J Am Geriatr Soc. 2011;59(9):1575–80.
25. Orriols L, Delorme B, Gadegbeku B, Tricotel A, Contrand B, Laumon B, et al. Prescription medicines and the risk of road traffic crashes: a French registry-based study. PLoS Med. 2010;7(11):e1000366.
26. Association AA. Roadwise RX. www.roadwiserx.com. Cited 28 April 2015.
27. American Geriatrics Society Beers Criteria Update Expert P. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2012;60(4):616–31.

28. Gallagher P, Ryan C, Byrne S, Kennedy J, O'Mahony D. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation. Int J Clin Pharmacol Ther. 2008;46(2):72–83.
29. Grabowski DC, Campbell CM, Morrisey MA. Elderly licensure laws and motor vehicle fatalities. JAMA. 2004;291(23):2840–6.
30. Monestam E, Lundquist B, Wachtmeister L. Visual function and car driving: longitudinal results 5 years after cataract surgery in a population. Br J Ophthalmol. 2005;89(4):459–63.
31. Ivers RQ, Mitchell P, Cumming RG. Sensory impairment and driving: the Blue Mountains Eye Study. Am J Public Health. 1999;89(1):85–7.
32. Green KA, McGwin Jr G, Owsley C. Associations between visual, hearing, and dual sensory impairments and history of motor vehicle collision involvement of older drivers. J Am Geriatr Soc. 2013;61(2):252–7.
33. Hickson L, Wood J, Chaparro A, Lacherez P, Marszalek R. Hearing impairment affects older people's ability to drive in the presence of distracters. J Am Geriatr Soc. 2010;58(6): 1097–103.
34. Gaspar JG, Neider MB, Kramer AF. Falls risk and simulated driving performance in older adults. J Aging Res. 2013;2013:356948.
35. Waller JA. Chronic medical conditions and traffic safety: review of the California experience. N Engl J Med. 1965;273(26):1413–20.
36. Arita A, Sasanabe R, Hasegawa R, Nomura A, Hori R, Mano M, et al. Risk factors for automobile accidents caused by falling asleep while driving in obstructive sleep apnea syndrome. Sleep Breath. 2015;19:1229–34.
37. Barger LK, Rajaratnam SM, Wang W, O'Brien CS, Sullivan JP, Qadri S, et al. Common sleep disorders increase risk of motor vehicle crashes and adverse health outcomes in firefighters. J Clin Sleep Med. 2015;11:233–40.
38. Ayas N, Skomro R, Blackman A, Curren K, Fitzpatrick M, Fleetham J, et al. Obstructive sleep apnea and driving: a Canadian Thoracic Society and Canadian Sleep Society position paper. Can Respir J. 2014;21(2):114–23.
39. Strohl KP, Brown DB, Collop N, George C, Grunstein R, Han F, et al. An official American Thoracic Society Clinical Practice Guideline: sleep apnea, sleepiness, and driving risk in noncommercial drivers. An update of a 1994 Statement. Am J Respir Crit Care Med. 2013;187(11):1259–66.
40. Hartenbaum N, Collop N, Rosen IM, Phillips B, George CF, Rowley JA, et al. Sleep apnea and commercial motor vehicle operators: statement from the joint task force of the American College of Chest Physicians, the American College of Occupational and Environmental Medicine, and the National Sleep Foundation. Chest. 2006;130(3):902–5.
41. Association AM. ADReS. http://www.nhtsa.gov/people/injury/olddrive/OlderDriversBook/pages/Contents.html. Cited 28 April 2015.
42. Ott BR, Davis JD, Papandonatos GD, Hewitt S, Festa EK, Heindel WC, et al. Assessment of driving-related skills prediction of unsafe driving in older adults in the office setting. J Am Geriatr Soc. 2013;61(7):1164–9.
43. Marottoli RA, Mendes de Leon CF, Glass TA, Williams CS, Cooney Jr LM, Berkman LF, et al. Driving cessation and increased depressive symptoms: prospective evidence from the New Haven EPESE. Established Populations for Epidemiologic Studies of the Elderly. J Am Geriatr Soc. 1997;45(2):202–6.
44. Ragland DR, Satariano WA, MacLeod KE. Driving cessation and increased depressive symptoms. J Gerontol A Biol Sci Med Sci. 2005;60(3):399–403.
45. Edwards JD, Lunsman M, Perkins M, Rebok GW, Roth DL. Driving cessation and health trajectories in older adults. J Gerontol A Biol Sci Med Sci. 2009;64(12):1290–5.
46. Task force members, Vijgen J, Botto G, Camm J, Hoijer CJ, Jung W, et al. Consensus statement of the European Heart Rhythm Association: updated recommendations for driving by patients with implantable cardioverter defibrillators. Europace. 2009;11(8):1097–107.

47. Epstein AE, Baessler CA, Curtis AB, Estes 3rd NA, Gersh BJ, Grubb B, et al. Addendum to "Personal and public safety issues related to arrhythmias that may affect consciousness: implications for regulation and physician recommendations: a medical/scientific statement from the American Heart Association and the North American Society of Pacing and Electrophysiology": public safety issues in patients with implantable defibrillators: a scientific statement from the American Heart Association and the Heart Rhythm Society. Circulation. 2007;115(9):1170–6.
48. Marecek GS, Schafer MF. Driving after orthopaedic surgery. J Am Acad Orthop Surg. 2013;21(11):696–706.
49. Goodwin D, Baecher N, Pitta M, Letzelter J, Marcel J, Argintar E. Driving after orthopedic surgery. Orthopedics. 2013;36(6):469–74.